1. A method for simulating fluid flow within a mold cavity, the method comprising the steps of:

(a) providing a surface representation for a three-dimensional volume associated with a mold cavity;

(b) separating the surface representation into at least a first portion and a second portion, the first portion of the surface representation being associated with at least one section of the volume having at least one of (i) a substantially invariant thickness and (ii) a gradually varying thickness along a length thereof;

(c) discretizing a first portion of a solution domain bound on an exterior thereof by the first portion of the surface representation;

(d) discretizing a second portion of the solution domain bound on an exterior thereof by the second portion of the surface representation;

(e) defining a plurality of interface elements for the solution domain that connect at least part of the first portion of the solution domain to at least part of the second portion of the solution domain;

(f) obtaining values of at least one process variable for the first portion of the solution domain using a first set of governing equations; and

(g) obtaining values of the at least one process variable for the second portion of the solution domain using a second set of governing equations.

2. The method according to claim 1, wherein step (b) is performed automatically.

3. The method according to claim 2, wherein at least one of step (c), step (d), and step (e) is performed automatically.

4. The method according to claim 2, wherein at least two of step (c), step (d), and step (e) are performed automatically.

5. The method according to claim 1, wherein the surface representation is a surface mesh.

6. The method according to claim 1, wherein the volume represents a molded object.

7. The method according to claim 1, wherein the volume represents a mold cavity.

8. The method according to claim 1, wherein the first set of governing equations in step (f), the second set of governing equations in step (g), and a set of interface element equations are solved simultaneously, subject to initial conditions and boundary conditions.

9. The method of claim 8, wherein the interface element equations link a portion of the solution domain described by governing equations in two spatial dimensions to a portion of the solution domain described by governing equations in three spatial dimensions.

10. The method according to claim 1, wherein the at least one process variable is selected from the group consisting of temperature, pressure, fluid velocity, stress, and fluid flow front position.

11. The method according to claim 1, wherein there are at least two process variables selected from the group consisting of temperature, pressure, fluid velocity, stress, and fluid flow front position.

12. The method according to claim 1, wherein there are at least three process variables including temperature, pressure, and fluid velocity.

13. The method according to claim 1, wherein the method simulates fluid injection in the three-dimensional volume.

14. The method according to claim 13, wherein the method further comprises determining a location of at least one injection point.

15. The method according to claim 1, wherein step (a) comprises providing the surface representation from CAD system output.

16. The method according to claim 15, wherein the CAD system output is in stereolithography format or IGES format.

17. The method according to claim 15, wherein the CAD system output defines a surface mesh comprising polygonal elements.

18. The method according to claim 17, wherein the polygonal elements are triangular elements or quadrilateral elements.

19. The method according to claim 15, wherein the CAD system output defines a three-dimensional mesh.

20. The method according to claim 19, wherein the surface representation is provided from a lattice of polygons that bound the three-dimensional mesh.

21. The method according to claim 15, wherein step (a) comprises using the CAD system output as a preliminary mesh and remeshing the preliminary mesh to provide the surface representation.

22. The method according to claim 1, wherein step (a) comprises providing a surface representation comprising a mesh of polygonal surface elements.

23. The method according to claim 22, wherein step (b) comprises defining two or more subsurfaces, each subsurface comprising at least one of the surface elements.

24. The method according to claim 23, wherein step (b) comprises determining element properties and nodal properties for each of the surface elements.

25. The method according to claim 24, wherein step (b) comprises using at least a subset of the element properties and nodal properties to classify each of the two or more subsurfaces according to curvature.

26. The method according to claim 23, wherein step (b) comprises defining at least one surface loop, each comprising a connected subset of edges of the surface representation.

27. The method according to claim 23, wherein step (b) comprises remeshing at least a subset of the two or more subsurfaces using a bisection algorithm.

28. The method according to claim 23, wherein step (b) comprises determining which of the two or more subsurfaces are matched subsurfaces.

29. The method according to claim 28, wherein each pair of matched subsurfaces is separated by a definable thickness.

30. The method according to claim 28, wherein the first portion of the surface representation comprises at least a subset of the matched subsurfaces.

31. The method according to claim 23, wherein step (b) comprises determining which of the two or more subsurfaces are unmatched subsurfaces.

32. The method according to claim 31, wherein the second portion of the surface representation comprises at least a subset of the unmatched subsurfaces.

33. The method according to claim 23, wherein step (b) comprises determining which of the two or more subsurfaces are edge subsurfaces.

34. The method according to claim 28, wherein step (c) comprises projecting at least one of the surface elements from one subsurface in a substantially perpendicular direction onto a matched subsurface thereof, thereby defining paired surface elements.

35. The method according to claim 34, wherein step (c) comprises converting the paired surface elements into wedge elements.

36. The method according to claim 1, wherein step (c) comprises automatically discretizing the first portion of the solution domain.

37. The method according to claim 1, wherein discretizing in step (c) comprises using the first portion of the surface representation to define the first portion of the solution domain.

38. The method according to claim 1, wherein step (c) comprises discretizing the first portion of the solution domain using wedge elements.

39. The method according to claim 38, wherein at least one of the wedge elements comprises at least one solution grid point along a thickness thereof.

40. The method according to claim 38, wherein at least one of the wedge elements is a discretely layered element or a continuously layered element.

41. The method according to claim 1, wherein step (d) comprises automatically discretizing the second portion of the solution domain.

42. The method according to claim 1, wherein step (c) comprises discretizing the first portion of the solution domain using hexahedral elements.

43. The method according to claim 1, wherein step (c) comprises discretizing the first portion of the solution domain using shell elements.

44. The method according to claim 1, wherein step (d) comprises discretizing the second portion of the solution domain using polyhedral elements.

45. The method according to claim 44, wherein the polyhedral elements are tetrahedral elements or hexahedral elements.

46. The method according to claim 1, wherein step (e) comprises defining a set of line interface elements.

47. The method according to claim 46, wherein each of the line interface elements is located along an interface of the first portion of the solution domain and the second portion of the solution domain.

48. The method according to claim 46, wherein each of the line interface elements comprises at least two nodes of a wedge element of the first portion of the solution domain.

49. The method according to claim 48, wherein each of the line interface elements further comprises at least one solution grid point between two of the at least two nodes.

50. The method according to claim 1, wherein step (e) comprises defining a set of planar interface elements.

51. The method according to claim 1, wherein step (c) is initiated before step (e).

52. The method according to claim 1, wherein step (e) is initiated before step (d).

53. The method according to claim 1, wherein the first set of governing equations describes fluid flow in two spatial dimensions.

54. The method according to claim 1, wherein the first set of governing equations describes fluid flow in two spatial dimensions and time.

55. The method according to claim 1, wherein the first set of governing equations describes fluid flow in one spatial dimension and time.

56. The method according to claim 1, wherein step (f) comprises using a Hele-Shaw approximation.

57. The method according to claim 1, wherein step (g) comprises solving a Navier Stokes equation.

58. The method according to claim 1, wherein step (g) comprises solving a simplified Stokes equation.

59. The method according to claim 1, wherein the second set of governing equations comprises conservation of mass, conservation of momentum, and conservation of energy equations.

60. The method according to claim 1, wherein at least one of step (f) and step (g) comprises using a meshless scheme.

61. The method according to claim 60, wherein the meshless scheme is a boundary element method, natural element method, or smooth particle hydrodynamics method.

62. The method according to claim 1, further comprising the step of:

(h) displaying the values of the at least one process variable directly on a 3D representation of the volume.

63. The method according to claim 1, wherein step (g) comprises using a Mini element formulation.

64. A method for simulating fluid flow within a mold cavity, the method comprising the steps of:

(a) providing a surface representation for a three-dimensional volume associated with a mold cavity;

(b) automatically separating the surface representation into at least a first portion and a second portion;

(c) defining a solution domain for the three-dimensional volume, where the solution domain comprises a first part corresponding to the first portion of the surface representation and a second part corresponding to the second portion of the surface representation;

(d) solving for a process variable in the first part of the solution domain; and

(e) solving for the process variable in the second part of the solution domain.

65. The method according to claim 64, wherein the first portion of the surface representation in step (b) is associated with at least one section of the volume that has at least one of (i) a substantially invariant thickness and (ii) a gradually varying thickness along a length thereof.

66. The method according to claim 64, wherein step (c) comprises automatically discretizing the first part and the second part of the solution domain.

67. The method according to claim 64, further comprising the step of defining a plurality of interface elements that connect the first part of the solution domain to the second part of the solution domain.

68. The method according to claim 64, wherein step (d) comprises using a first set of governing equations and step (e) comprises using a second set of governing equations.

69. The method according to claim 68, wherein the first set of governing equations describes 2.5D flow and the second set of governing equations describes 3D flow.

70. A method for automatically defining a hybrid solution domain, the method comprising the steps of:

(a) identifying a plurality of subsurfaces of a volume associated with a mold cavity using a representation of the surface of the volume;

(b) matching one or more pairs of the plurality of subsurfaces to identify one or more matched pairs of subsurfaces and one or more unmatched subsurfaces; and

(c) defining

(i) a first portion of a hybrid solution domain bound at least in part by one or more of the matched pairs of subsurfaces and

(ii) a second portion of the hybrid solution domain bound at least in part by one or more of the unmatched subsurfaces.

71. The method according to claim 70, wherein the volume represents a mold cavity.

72. The method according to claim 71, further comprising using the hybrid solution domain to model a molding process.

73. The method according to claim 70, wherein the representation of the surface of the volume comprises CAD system output.

74. The method according to claim 70, wherein the first portion of the hybrid solution domain is amenable to 2.5D flow analysis, and the second portion of the hybrid solution domain is amendable to 3D flow analysis.

75. The method according to claim 70, wherein step (b) comprises classifying each of the plurality of subsurfaces according to curvature.

76. The method according to claim 70, wherein the matched pairs of subsurfaces each comprise two subsurfaces that are separated by a substantially constant thickness.

77. The method according to claim 70, wherein the volume represents a molded object.

78. The method according to claim 77, further comprising using the hybrid solution domain in determining a structural property of the molded object.

79. The method according to claim 78, wherein the structural property is warpage.

80. An apparatus for simulating fluid flow within a mold cavity, the apparatus comprising:

(a) a memory that stores code defining a set of instructions; and

(b) a processor that executes said instructions thereby to

(i) separate a surface representation of a three-dimensional volume associated with a mold cavity into at least a first portion and a second portion, the first portion of the surface representation being associated with at least one section of the volume having at least one of (i) a substantially invariant thickness and (ii) a gradually varying thickness along a length thereof;

(ii) discretize a first portion of a solution domain bound on an exterior thereof by the first portion of the surface representation;

(iii) discretize a second portion of the solution domain bound on an exterior thereof by the second portion of the surface representation;

(iv) define a plurality of interface elements for the solution domain that connect at least part of the first portion of the solution domain to at least part of the second portion of the solution domain;

(v) obtain values of at least one process variable for the first portion of the solution domain using a first set of governing equations; and

(vi) obtain values of the at least one process variable for the second portion of the solution domain using a second set of governing equations.

81. An apparatus for defining a hybrid solution domain, the apparatus comprising:

(a) a memory that stores code defining a set of instructions; and

(b) a processor that executes said instructions thereby to

(i) identify a plurality of subsurfaces of a volume associated with a mold cavity using a representation of the surface of the volume;

(ii) match one or more pairs of the plurality of subsurfaces to identify one or more matched pairs of subsurfaces and one or more unmatched subsurfaces; and

(iii) define

(A) a first portion of a hybrid solution domain bound at least in part by one or more of the matched pairs of subsurfaces and

(B) a second portion of the hybrid solution domain bound at least in part by one or more of the unmatched subsurfaces.

82. The method of claim 2, further comprising the step of re-characterizing a subset of the second portion of the solution domain as belonging to the first portion according to user input.

83. The method of claim 2, further comprising the step of re-characterizing a subset of the first portion of the solution domain as belonging to the second portion according to user input.

84. The method of claim 1, wherein step (b) comprises separating the surface representation into a first portion, a second portion, and at least one additional portion.